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In spite of the many criticisms made of the BASIC 2 in the VIC-20 and Commodore 64, these machines have a particularly useful virtue — their flexibility. Or, to put it another way, expandability.

Both are equipped with user, games and expansion ports. Via these it is possible to interface to a wide range of hardware add-ons. The value of this standard on-board hardware is demonstrated when one considers how many extras must be purchased to use joysticks and Micro-drives on a Spectrum.

The aim of this article is to present a review of the hardware add-ons available for the VIC-20 and Commodore 64.

Clearly, it is not feasible to cover all of them here. Consequently, I will review a selection. The basic criterion for selection was that, as far as possible, I have personally used the add-ons. Some items, because of cost or difficulty in getting review specimens, do not fulfil this criterion. These are marked with an asterisk (*).

Using this approach, while I don't cover all the bits and pieces available, I can vouch for those I do discuss.

Similarly, there will be a number of manufacturers whom I will not mention. Quite possibly such manufacturers will be able to offer cheaper products than those reviewed. If so, my apologies. However, due to limitations of space, I cannot cover every product available.

To assist you in finding the sections you want, I shall cover the hardware under the headings of their generic classes, e.g. Memory Expansion, Toolkits and so on.

The first real problem

was to establish which products fell within the sphere of this review. The

simple answer is: any product which uses a piece of hardware. I will, for

example, mention ROM-based Forth but not Forth on cassette or disc.

Your guide to add-ons for the VIC-20 and Commodore 64

Memory	five
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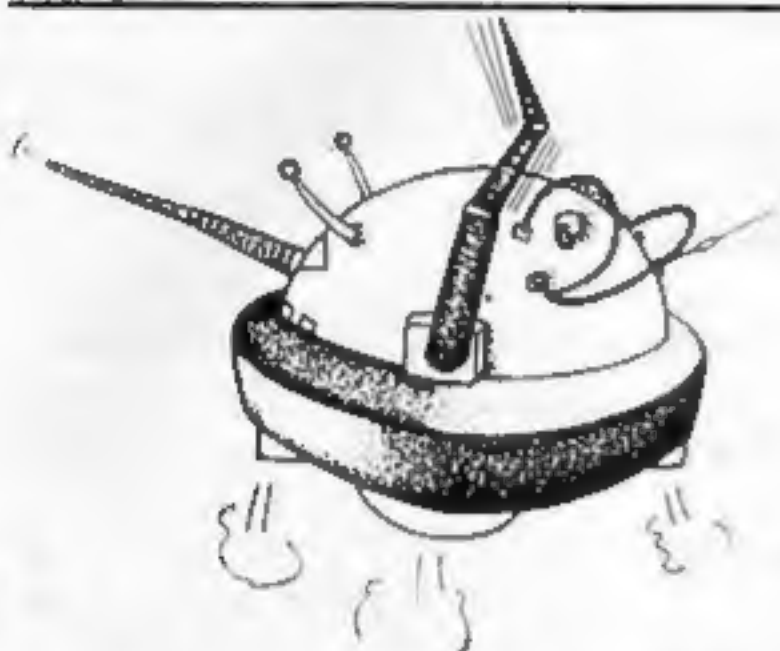
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MEMORY

Probably the first add-on purchased by many VIC owners will be some kind of memory expansion. After a slow start, the number of firms producing these has increased. Most expansions are of the cartridge format with a fixed block of RAM (generally 3K, 8K or 16K). One or two of the 16K packs also contain the option of changing the memory configuration.

There are also one or two firms offering 32K and 64K memory packs, but be warned such extra RAM is really only of value to the machine code user (the 6502 chip can only address 64K and a large slice of that is pinched by ROM etc.)

In my view the firms worth consideration are Commodore (3K, £19.95; 8K, £29.95; 16K, £34.95), Stonechip Electronics (16K switchable, £34.95) and Adman* (8K, £39.95; 16K, £49.95).

Stack Computers does a rather nice RAM board. The value of this is that you can add chips (6116) as and when you like and any memory configuration can be set up. I've had one for a couple of years without any problems (basic board with 8K and toolkit, £39; extra 8K, £18; extra 4K, £10).

Since the 64 already has a full complement of RAM, I don't know of any RAM add-ons for it.

TOOLKITS

One of the weaknesses of the Commodore BASIC is the absence of commands which ease the task of writing and debugging programs. As a consequence, a number of firms have produced add-on ROMs which extend the number of commands available. Typical of these commands are DELETE, RENUMBER, AUTO, TRACE and so on.

Two types of hardware are used, cartridges and ROM chips. The latter require a socket on an expansion board, e.g. Stack storeboard or Stonechip's motherboard.

● Light pen from Stonechip



Some worth looking at are Stack's VICKIT 1 (£23 ROM or £28.75 cartridge) and VICKIT 2 (£27 and £40.25), Stonechip (BASIC Plus £14.95 as ROM or £22.45 as cartridge), Audiogenic (BUTI Plus £39.95 cartridge), Commodore (Programmer's Aid Cartridge, £32).

Some packages include 3K of RAM: BUTI Plus by Audiogenic (see above) and Supercharger Plus by Stack. For those with more than one ROM, Stack makes a multi-ROM carrier at £14.

For the 64 toolkits are available from: Stack* (Help, £25; Super Help, £35; Arrow, £29; and Arrow Plus, £39), Super-soft (Arrow, £39; Victree, a toolkit plus BASIC 4 disk commands — highly recommended, £49), Commodore* (Simon's BASIC...£45).



JOYSTICKS

Owners of Commodore computers are fortunate in that they can plug a joystick straight into the computer without recourse to an add-on interface. Unlike the other items discussed in this review, choice of joysticks is really a matter of personal taste and size of your bank balance.

If your budget is limited, I would suggest the Atari joystick. At about £7, it is cheap and will take a lot of hammering. (Don't buy the Commodore joystick since it is only an Atari with a new paint job). A little more expensive is the Spectravideo Quickshot Stick which offers a moulded handle and a fire button on the top. Not bad value at about £10, but perhaps less sturdy than the Atari.

● IEEE-488 interface from Stack

I've used both of these sticks and can recommend them.

For completeness, I'll mention a few others which I have not used but appear to be good value. Suncom* markets four joysticks which look rather tasty. They seem to cover the full range of types available and look like value for money. Spectrum users will know of the Kempston Competition Pro* (£14.50). It looks handy and no interface is necessary for Commodore computers.

For the more adventurous, Stonechip makes a stick using mercury switches* (£20). Instead of using the normal mechanical switch, the joystick reacts to the angle at which it is held. Given practice, this arrangement gives much more precise control without getting cramp in your wrist.

MACHINE CODE MONITORS

Owners of Commodore PETS have an advantage over VIC and 64 owners in that they have a machine code monitor on board in ROM. We VIC and 64 owners must buy one separately. In case you don't know what it does, a machine code monitor enables you to perform a wide range of actions on machine code and memory contents and it's really a must for the serious computer freak.

For the VIC owner I suggest: Commodore (Machine Language Monitor Cartridge, £28), Audiogenic (BUTI Plus see Toolkits, Monitor, £29.95).

For the 64: Stack (Help and Superhelp, see Toolkits), Supersoft (Zoom Monitor, at £25 probably the best available) and Audiogenic* (Monitor, £29.95).

MOTHER-BOARDS

Both the VIC and 64 have only one expansion port. Consequently it is necessary to remove the resident cartridge before using a new

● **Four-slot motherboard with ROM socket from Stonechip**

one. A large number of insertions and removals can damage the gold plating on the cartridge edge connector and subsequently cause problems.

The solution is a motherboard with several sockets. You can then have all your cartridges in place all the time and switch any one in when you want. The better known manufacturers are Commodore * (six-slot board for VIC, £59.95), Adman * (three-slot board for VIC, £19.95), Stack (four-slot boards for VIC, £24, and four-slot board for the 64, £29), Stonechip * (four-slot board plus ROM socket for VIC, £31.95).

The switching of the cartridges is normally by mechanical switches although it is not clear how the Commodore board does this.

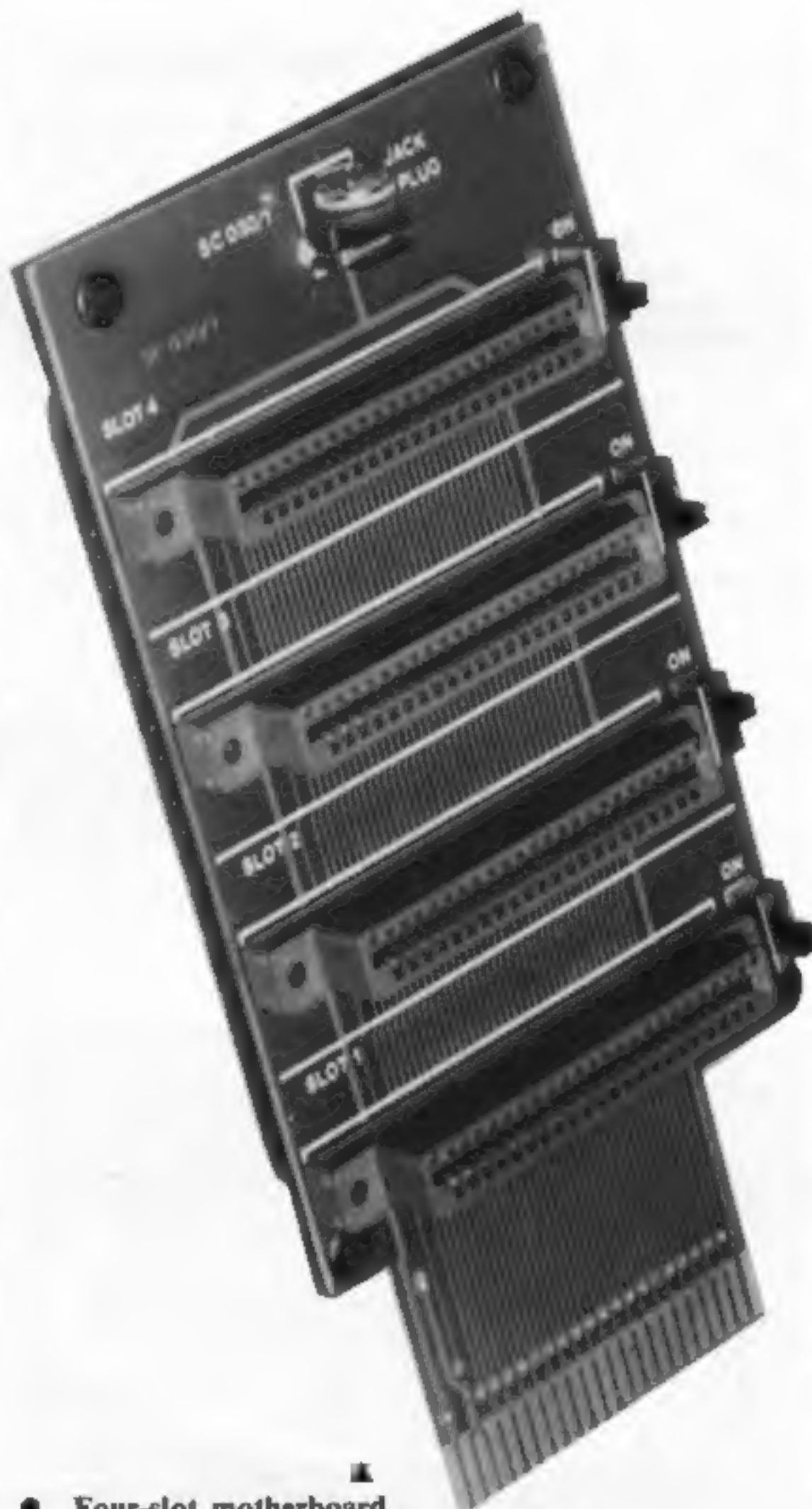
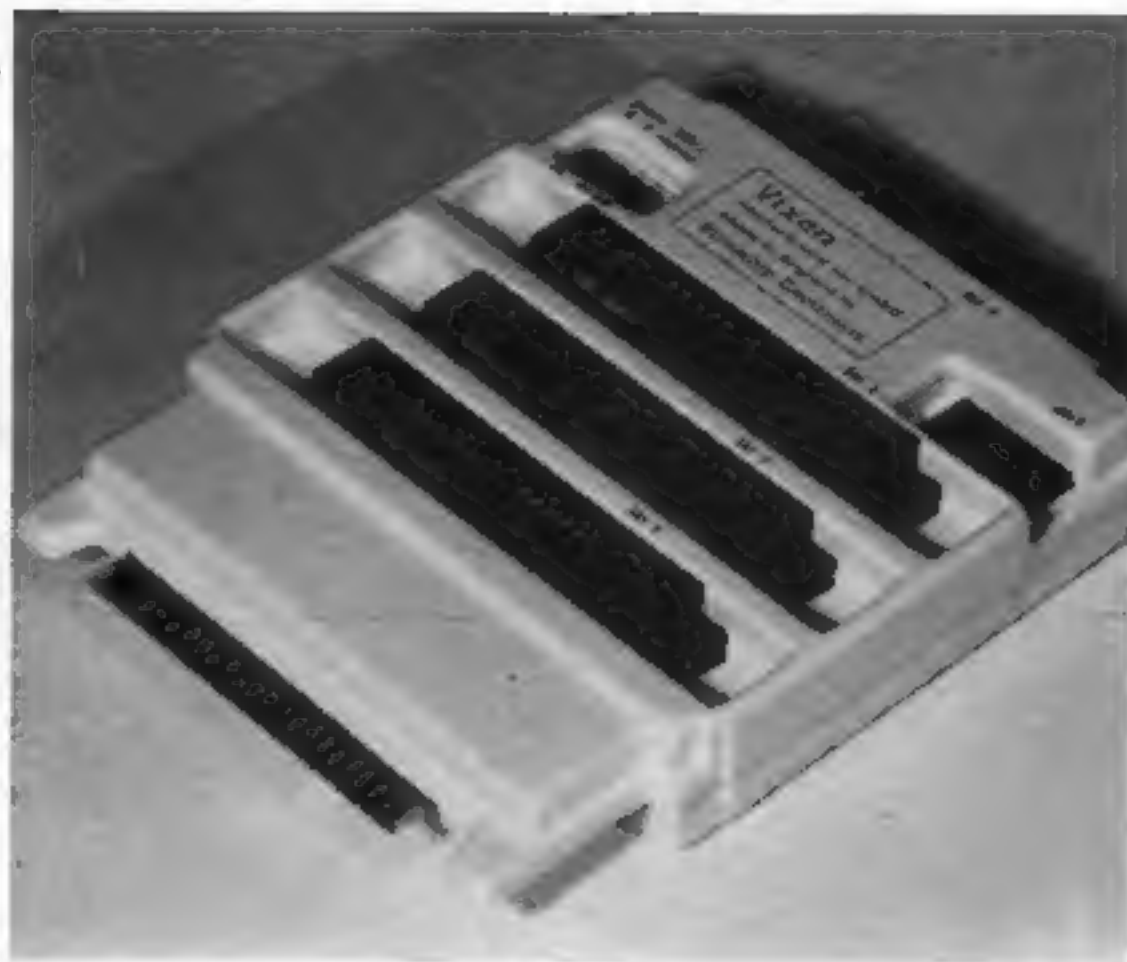
ASSEMBLERS

For machine code routines of significant size there is no alternative to the use of an assembler. A decent one should include a monitor, standard pseudo-op codes and operate with at least two passes. For the VIC: Audiogenic (MIKRO Assembler, £49.95 and excellent) and Stack * (VICKIT 5, £33.35). If you have a 64 you could do a lot worse than get Supersoft's Mikro Assembler (£50).

FAST SAVERS

It's a sad fact of life that most of us can't afford a disc drive. It's even sadder how long it takes to load a large program from cassette. In an attempt to make life a little happier for those of us with only cassette units, some firms have produced aids to help. These devices save and load programs at speeds several times faster than the normal routines.

Programs saved using such aids cannot be loaded normally. If you have the spare cash, these aids are worth a look: Stack * (Hi-Speed Cassette for the VIC, £33.95; Arrow and Arrow Plus for the 64, see Toolkits) and Supersoft's Arrow for the 64 (£39).



● **Four-slot motherboard for the Commodore 64 from Stack**

GRAPHICS AIDS

The VIC and 64 have a lot of untapped graphics ability which, due to the lousy BASIC, are not immediately available to the user. In a belated attempt to make amends Commodore has issued software for both. But, overall, it's been other companies which have come to the rescue.

Most packages enable you to make high resolution pictures using such standard commands as DRAW, POINT, CIRCLE, FILL and so on. I personally feel that such aids are of great value and offer a lot of scope.

The products I know of are: Stack (VICKIT 2, £40 and VICKIT 3, £33 — very versatile but do not support multicolour graphics directly), Commodore, (Superexpander plus 3K RAM, £31 — easy to use but crudely written), Supersoft (MIKRO Assembler, ... graphics added to fill space but commands are very good. See under Assemblers).


For the 64 there are some excellent cassette and disc based dedicated packages. In hardware there are Simon's BASIC from Commodore * (£50 — expensive, poor reviews) and BC BASIC from Kuma Computers * (£49).

IEEE INTERFACES

Apart from being good games machines, Commodore computers are also well equipped to perform many serious tasks. One way of getting the machine to talk to the outside world and perform such tasks is via the IEEE bus. The disc drive and printer use a sort of IEEE through the serial port, but for a proper IEEE, you must get an interface. Several are on the market. I have not tested them. Some suppliers are: Stack * (IEEE-488 cartridge, £45 for VIC & 64), JCL * (VIC and 64, £59), Oxford Computer systems * (Interpod for VIC and 64, includes RS 232, £99.95), DAMS, now named Computapix * (VIC and 64, £62.10, includes Centronics interface).

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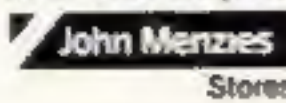

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● Range of VIC-20 cartridges, plus four-slot motherboard, from Stack

LANGUAGES

A much neglected area. The strength of the Commodore machines is the ease with which alternative or extended languages can be installed. As far as I know, however, the only languages available in the UK are Forth and extensions to BASIC.

For the VIC try Audiogenic's Forth (£24.95 or £39.95 with 3K of RAM). For the 64 there is also Forth by Audiogenic (£29.95). There is also a Forth package from Kobra * (£28.95).

If you are cheesed off with the paucity of commands in CBM BASIC, there are two packages available for the 64: Simon's BASIC (see Graphics aids) and BC BASIC from Kuma (£49). BC BASIC offers fewer commands but is significantly superior to Simon's BASIC.

RADIO TELETYPE

The home computer has been adopted by many radio hams to assist in the receipt and transmission of morse. I've only seen adverts from one firm, Computer World. It produces RTTY boards for both the VIC and the 64 (64 board costs £139). I haven't seen this product and, since the firm is Dutch, I cannot vouch for it.

● Interpod, the IEEE and RS 232 interface for the VIC-20 and CBM 64, from Oxford Computer Systems



SPEECH SYNTHESIS

Nearly all science fiction computers and robots seem to have an ability to converse with humans in immaculate English. There are now devices on the market which strive to achieve similar speech, albeit of inferior quality — most sound like Metal Mickey.

In spite of such limitations, such devices have a value in adventures and educational software. I know of one such device for the VIC-20: ADMAN Speech Synthesiser (£49.95). The unit is in cartridge form and functions well.

LIGHT PENS

The VIC and 64 are particularly well endowed with input ports. One of the

on-board facilities is the ability to interpret input from a light pen.

When pointed at the screen, a light pen will detect the position of the raster scan and this can be converted to the position on the screen by a bit of software. Using this technique, you can, subject to the resolution of the system, detect the position of objects on the screen. Light pens are valuable for games and graphics.

From: Stack * (£25), Stonechip (£19.95) and DAMS/Computapix * (£26.99).

Stack Computers also markets a light pen built in the barrel of a toy rifle. This can be used for marksman-type games (£29.95) and some software houses have programs which use it.

WEBB'S WINNERS

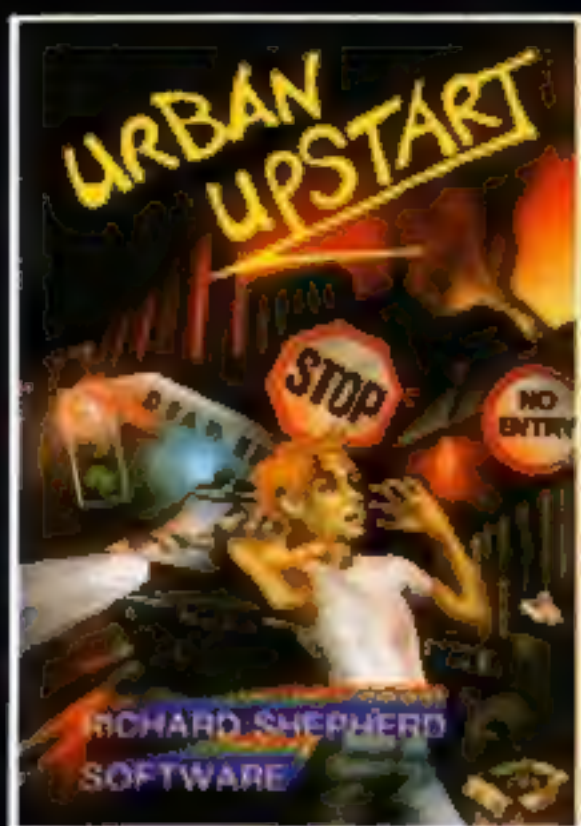
Well I hope this has given a good thumb-nail sketch of the add-on market. It's really up to you to get the specifications and make your own choice. For what it's worth, here are the items which I personally think are the best available:

RAM expansion Assembler	Stack Storeboard Mikro Assembler for either machine
Monitor	Zoom Monitor
Graphics aid (VIC)	VICKIT 2
Audiogenic Forth	both machines



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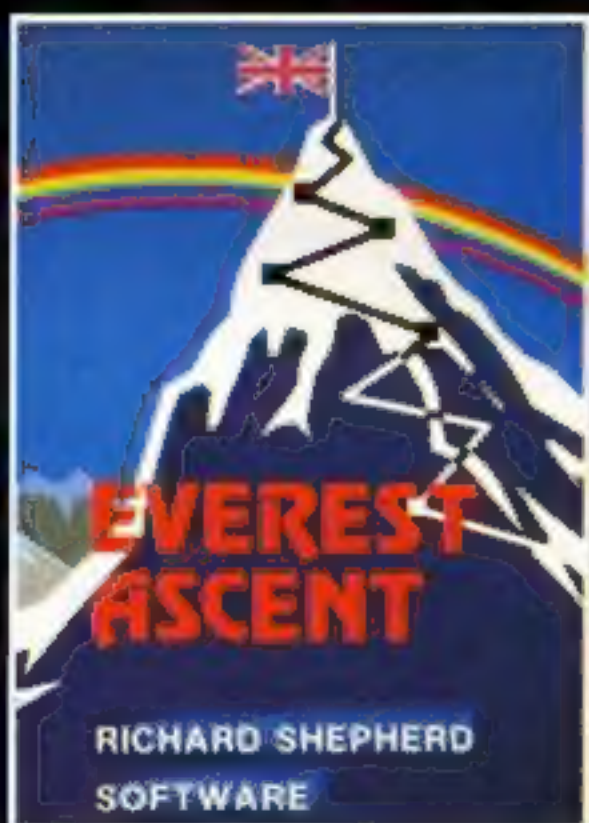
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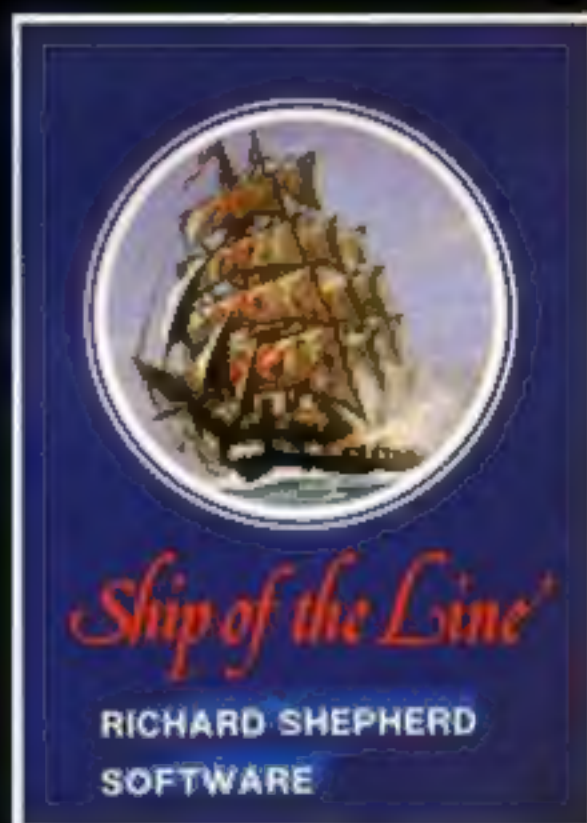
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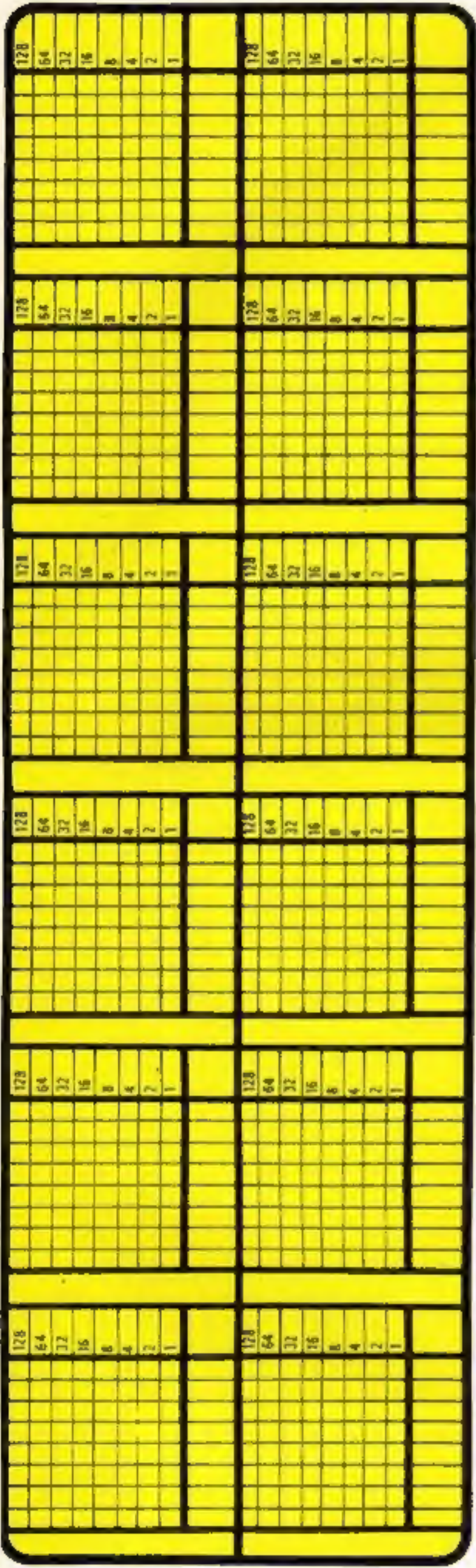
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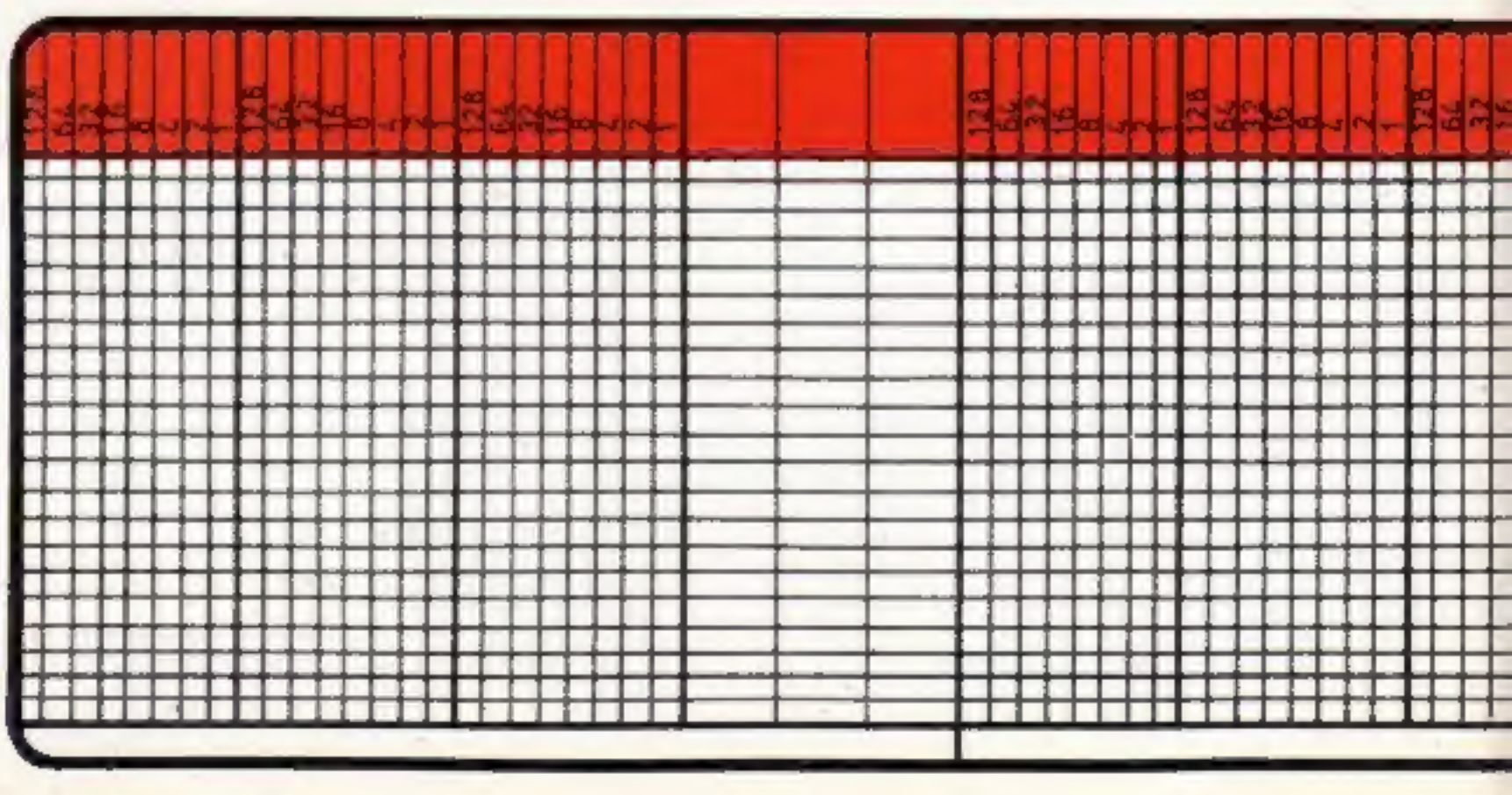
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Kobra Micro Marketing, Unit 8, 1/7 Broomfield Road, West Ealing, London W17 9AP
Kuma Computers, Unit 12, Horseshoe Park, Horseshoe Road, Pangbourne, Berks RG8 7JW
Oxford Computer Systems, Hensington Road, Woodstock, Oxford OX7 1JR
Stack Computers, 290 - 298 Derby Road, Bootle, Liverpool L20 8LN
Stonechip Electronics, Brook Industrial Estate, Deadbrook Lane, Aldershot Hants
Supersoft, Winchester House, Canning Road, Wealdstone, Harrow, Middlesex HA3 7SJ

If you own a VIC-20 or Commodore 64, look no further for add-ons. Our expert, Allen Webb, has sorted out the best from the rest. Take his advice before you buy



● Light Rifle from Stack

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Many articles and a lot of software has been written about sprites to create good-looking games and other programs on the Commodore 64. But user-defined graphics have scarcely had a mention.

These useful characters, whether seen as background extras or as moving objects, play an important part in any good game. This article sets out to cure the chronic lack of information about them and will show you effects you would have thought impossible on the 64.

Firstly, you have to have a good idea of how to create UDGs. Next time you have your 64 on, look closely at the screen characters. If your TV is good enough, you will see that they are not smooth, but are made up of joined dots.

Each character actually has 64 such dots (or pixels), in a layout of eight pixels across by eight up. These characters are fixed graphics, held in ROM, and so cannot be changed. However, you can change the position where the computer looks to see the patterns to display by using the following line:

```
POKE 53272, (PEEK(53272)
AND240) OR X
```

where X is that viewing position. If X is four, five, six or seven, fixed characters are shown. Any other number will move the viewing position to RAM, where you decide what is to be seen.

The most useful number is 15, as this places the viewing position farthest from your program, giving you the most room with definitions starting at location 14336.

When you first change

viewing position, all the computer sees is unused RAM, so all you'll see are some oddly patterned characters. Clearly, most games will need some form of text, so the first thing to do is to copy some text characters to RAM, Lines 40 to 140 do this by uncovering the hidden character ROM, and PEEKing and POKEing in machine code.

Now you are all set to add your own characters (the sprite chapter of your manual will help).

Creating them is fairly similar in method to creating a sprite: the bytes are filled in the same way, but their layout is different. A UDG is simply eight bytes, set out as rows containing bits. Diagram 1 shows how this appears by showing character one as an example. As you can see, each byte total is the sum of the bit totals, from on bits. To change this, you simply POKE in your own numbers instead.

Program 2 is a simple character definer, aiding in design and adding of the bit totals. You move a flashing cursor backwards or forwards, using the space and return keys to empty or fill bits, respectively. When you have finished, press E, and use the byte totals at the side of the character.

Multicolour characters can also be created in the same way as with sprites. Here, sets of two bits are joined horizontally to make one screen pixel, but this can have four colours (one character colour, and three screen colours from locations 53281, 53282 and 53283). To switch multicolour mode on and off respectively, use the following lines:

Program 1 — uncovers the hidden character ROM

```
1 REM*****
2 REM*CREATING UDGs*
3 REM* BY *
4 REM* DAVID REES *
5 REM*****
9 REM* CODE FOR ROM READ *
10 FOR N=0 TO 33
20 READA POKE49152+N,A
30 NEXT
40 DATA169,0,133,251,133,253,169,56
50 DATA133,252,169,208,133,254,160,0
60 DATA177,253,145,251,200,208,249
70 DATA230,252,230,254,165,252
80 DATA201,64,208,239,96
99 REM* RUN MACHINE CODE *
100 V=53248 POKE56334,PEEK(56334)AND254
110 POKE1,PEEK(1)AND251
120 SYS49152
130 POKE1,PEEK(1)OR4
140 POKE56334,PEEK(56334)OR1
150 POKEV+24,(PEEK(V+24)AND240)OR15
160 POKEV+32,0 POKEV+33,0
```

```
199 REM*[CLS]
200 PRINT"J",
210 FOR N=0 TO 2
220 A$=A$+CHR$(160+N)+CHR$(157)+CHR$(17)
230 NEXT
239 REM*[UP*3]
240 A$=A$+CHR$(163)+"TTJ"
250 FOR Y=0 TO 4
260 FORN=0TO39 PRINTA$,NEXT
269 REM*[HOME]
270 PRINT"#####";NEXTY
280 FORN=0TO38 PRINTA$,NEXT
289 REM*.[HOME]
290 PRINTLEFT$(A$,10)"#"
299 REM* MAKE GRAPHICS PATTERNS *
300 X=15104 Y=31.9 Z=255 Q=170
310 FORN=0.1TO17STEP0.1
320 POKEX+M-N+0.1,85 K=N+0.1
330 FORM=NTOYSTEPN POKEX+M,Z POKEX+M-K,85 NEXT
340 NEXTN
360 FORN=0.1TO7STEP0.1
370 POKEX,Z POKEX+31,0
380 FORM=NTOYSTEPN POKEX+M,Z POKEX+M-N,0 NEXT
390 NEXTN
400 FORN=0.1TO7STEP0.03
410 POKEX,170 POKEX+31,85
420 FORM=NTOYSTEPN POKEX+M,0 POKEX+M-N,85 NEXT
430 NEXTN
```

Program 2 — a character definer

```
1 REM*****
2 REM*UDGS DESIGNER*
3 REM* BY *
4 REM* DAVID REES *
5 REM*****
9 REM* CODE FOR ROM READ *
10 FOR N=0 TO 33
20 READA POKE49152+N,A
30 NEXT
40 DATA169,0,133,251,133,253,169,56
50 DATA133,252,169,208,133,254,160,0
60 DATA177,253,145,251,200,208,249
70 DATA230,252,230,254,165,252
80 DATA201,64,208,239,96
99 REM* RUN MACHINE CODE *
100 V=53248 POKE56334,PEEK(56334)AND254
110 POKE1,PEEK(1)AND251
120 SYS49152
130 POKE1,PEEK(1)OR4
140 POKE56334,PEEK(56334)OR1
150 POKEV+24,(PEEK(V+24)AND240)OR15
160 POKEV+32,0 POKEV+33,0
199 REM*[CLS][BLUE][DWN]
200 PRINT"#####"
209 REM*.[RVS OFF][ORANGE]..[BLUE][RVS ON]
210 A$="#####"
219 REM*[RVS ON]
220 PRINT"##### 76543210 "
230 FOR N=0 TO 7
239 REM*[RVS ON]
240 PRINT"#####STR$(N),A$
249 REM*[UP]
250 PRINT"##### 0"
260 NEXTN
269 REM*[RVS ON]
270 PRINT"##### 76543210 "
280 PRINT"#####ENTER E TO END"
285 PRINT"##### 90"
290 S=1147 X=0 Y=0
300 P=S+X+Y*40
310 POKEP,PEEK(P)+128AND255
320 GETA$
330 POKEP,PEEK(P)+128AND255
340 IFA$="" THEN310
350 IFA$="I" THEN500
360 IFA$="II" THEN600
```

How to create good-looking games — thanks to UDGS

```
POKE 53270, PEEK(53270) OR
16
POKE 53270, PEEK(53270)
AND 239
```

Now that you have the characters, you can find out how versatile they are. UDGs can be endlessly repeated, like any character, so a few simple numbers and some PRINTing can be used to create great effects. For example, **Diagram 2** shows a UDG of part of a brick wall. It seems insignificant on its own, but can be repeated as many times as you like, to form a wall of any size.

Another simple improvement is to join several different characters together, to make one large character. Objects can be repeated as many times as you want, instead of having a limit of eight sprites.

However, UDGs become really impressive in this next part of the article. There are actually two types of UDG: hardware and software characters. The BBC and Spectrum use software characters by POKEing one byte of your (or its) design onto one byte of its high resolution screen. The '64 can do this, but it is easier to use hardware characters

Here, the computer sees your

```
370 IFA#=" " THEN 700
380 IFA# = CHR$(13) THEN 800
390 IFA# > "E" THEN 300
399 PEN#(DWH#4)
400 PRINT "XXXX"
410 END

500 X=X+1 IF X<8 THEN 300
510 Y=Y+1 IF Y<8 THEN 300
520 Y AND 7 GOTO 300
530 Y AND 7 GOTO 300
540 X=X-1 IF X>-1 THEN 300
550 Y=Y-1 IF Y>-1 THEN 300
560 Y AND 7 GOTO 300
570 Y AND 7 GOTO 300
700 B=X B=Y AND (255-2*(7-X)) GOSUB 900
710 POKE B, 122
720 GOTO 500
800 B=X B=Y OR 21 7-X GOSUB 900
810 POKE B, 250
820 GOTO 500
900 PEN#(HOME) (DWH#2)
900 PRINT "XXXX"
900 PEN#(LEFT)
910 FOR N=0 TO 33 PRINT " " " " NEXT
920 FOR D=15060+Y, B(Y)
930 RETURN
```

Program 3 — gives 64 by 64 resolution

```
1 REM*****
2 REM*UDGS HIGH-RES*
3 REM* BY *
4 REM* DAVID REES *
5 REM*****
9 REM* CODE FOR ROM READ *
10 FOR N=0 TO 33
20 READ A POKE 49152+N, A
30 NEXT
40 DATA 169,0,133,251,133,253,169,56
50 DATA 133,252,169,208,133,254,160,0
60 DATA 177,253,145,251,200,208,249
70 DATA 230,252,230,254,165,252
```

There's a chronic shortage of information about user-defined graphics on the Commodore 64. HCW regular David Rees sets out to cure this

(or its) character design, and displays it directly on the TV screen. If you want to change all of one type of UDG on the BBC, you would have to PRINT the new design over all the old characters. On the 64, you POKE directly to the character, and all of that type on the screen instantly.

This opens up many fantastic possibilities.

For instance, if you completely covered the screen with one repeated UDG, and changed the defined pattern of this character, the whole screen would change instantly. The latter part of program 1 shows some of the potential of this, by varying character patterns, and how the characters themselves can look. The result is displays which can only be graphically copied with super-fast drawing and calculations

You can even use UDGs to create a small graphics screen, as **Program 3** demonstrates. This gives a 64 by 64 resolution (saving memory) using 64 characters. This allows the rest to be used for text. Another advantage is that the screen is easily moved, as it is really just a pattern of characters. The screen is easily expandable up to a resolution of 128 by 128, or any format in steps of eight. Simply POKE out a different pattern, and change the point draw routine

Many other things can be done. You can manipulate characters in any way, turning them upside down, sideways, or even mixing their order. The possibilities are almost limitless.

All the above ideas can easily be used in games, whether they are to complement or replace sprites. The ideas can also be easily transferred to other computers, especially the VIC-20 with its similar hardware features

Your imagination is the final boundary of the superb displays that are possible.

COMMODORE 64

```

80 DATA201 64,208 239.95
99 REM* RUN MACHINE CODE *
100 V=53248 POKE56334,PEEK(56334)AND254
110 POKE1,PEEK(1)AND251
120 SYS49152
130 POKE1,PEEK(1)OR4
140 POKE56334,PEEK(56334)OR1
150 POKEV+24,PEEK(V+24)AND240)OR15
160 POKEV+32,0 POKEV+33,0
187 REM*DRAW CHARACTER PATTERN*
188 REM*.[RYS ON].[RYS OFF][ORANGE].
189 REM*.[BLUE][RYS ON]
190 H$=" 3 5]      33 "
199 REM*.[5][DWN].[RYS ON][BLUE]
200 PRINT "30 32 "
210 FORN=0TO7 PRINTA$ NEXT
219 PEM*[RYS ON]
220 P=1106 PRINT" 3 "
230 FORX=0TO7
240 FORY=0TO7
250 POKEP+X+Y*40,192+X*8+Y
260 NEXTY,X
270 P=14336+192*8
280 FORN=0TOS11 POKEP+N,0 NEXT
289 REM*[DWN]
290 PRINT"0A MINI HIGH RESOLUTION SCREEN"
299 REM*THE FUNCTION TO BE DRAWN*
300 FORC=0TOπSTEPπ/8 B=32*(π-C)/π
310 FORX=0TOJ63
320 Y=32-SIN(C/6+C)*B GOSUB500
330 NEXTX,C
490 END
499 REM* DRAW POINT*
500 S=P+Y+INT(X/8)*64 A=2↑7-(XAND7)
510 POKE5,PEEK(5)ORA RETURN

```

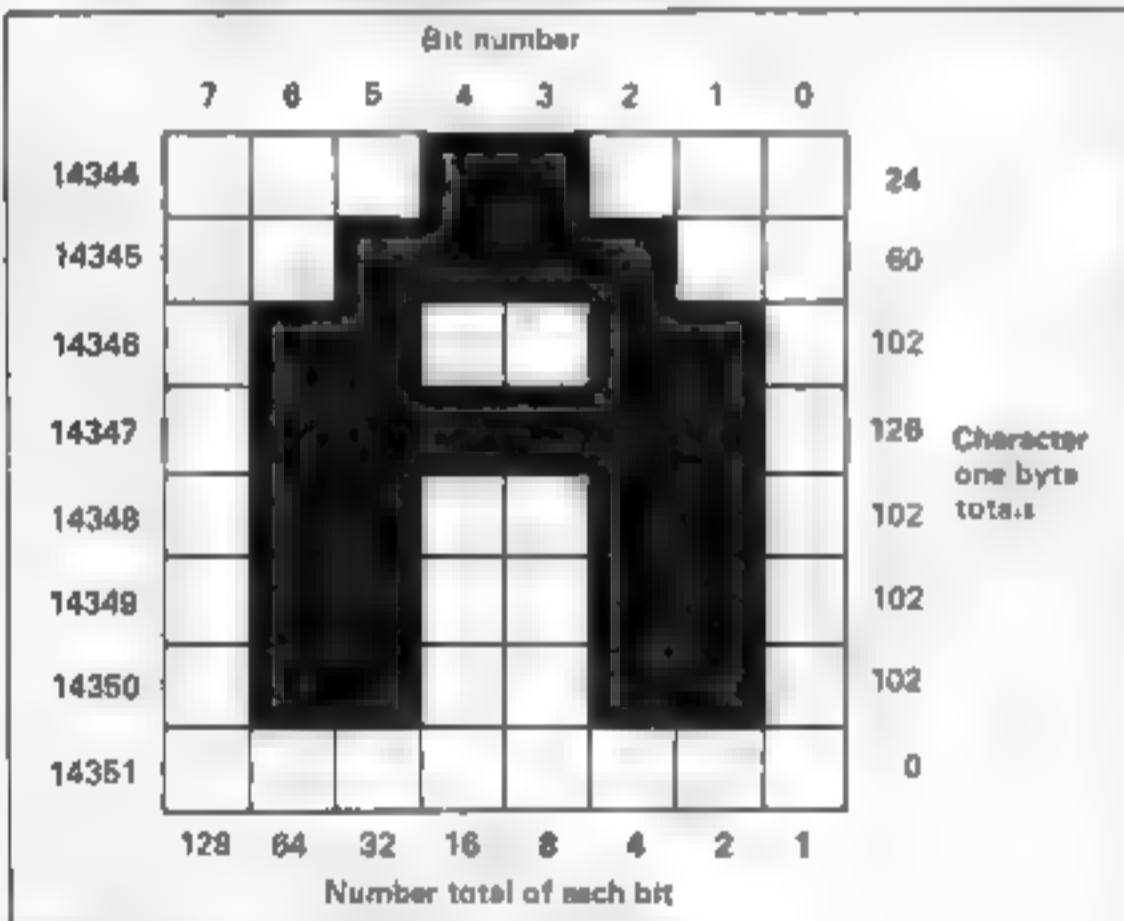


Diagram 1 — how characters can be built

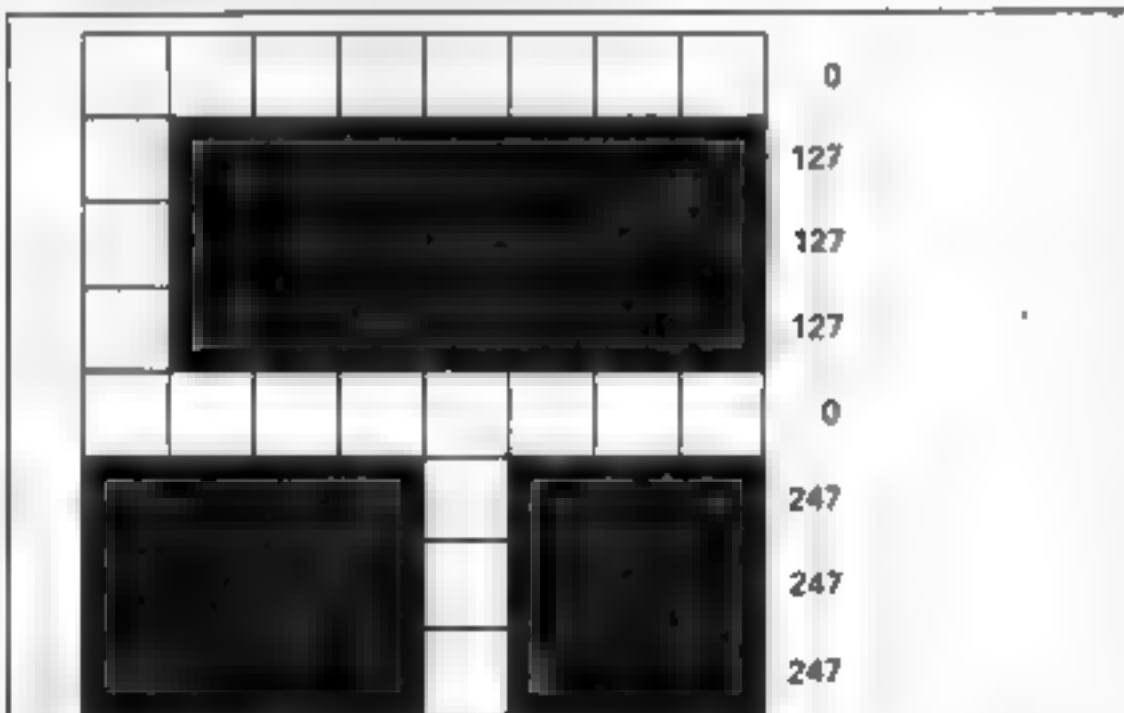


Diagram 2 — UDG of part of a brick wall

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All books written by Peter Gerrard, former editor of *Commodore Computing International*, author of two top-selling adventure games for the Commodore 64, or by Kevin Bergin. Both are regular contributors to *Personal Computer News*, *Which Micro?* and *Software Review*

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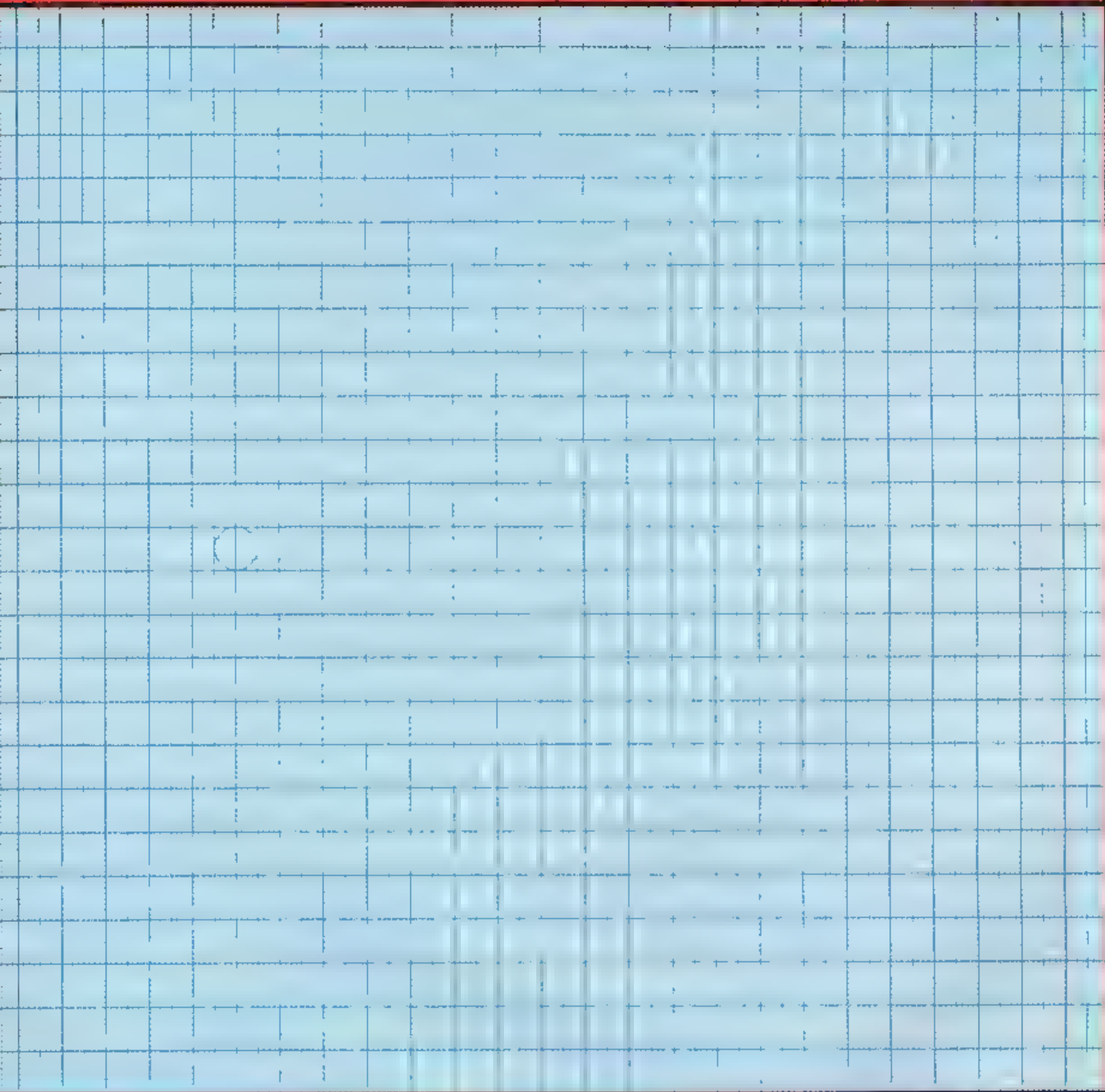
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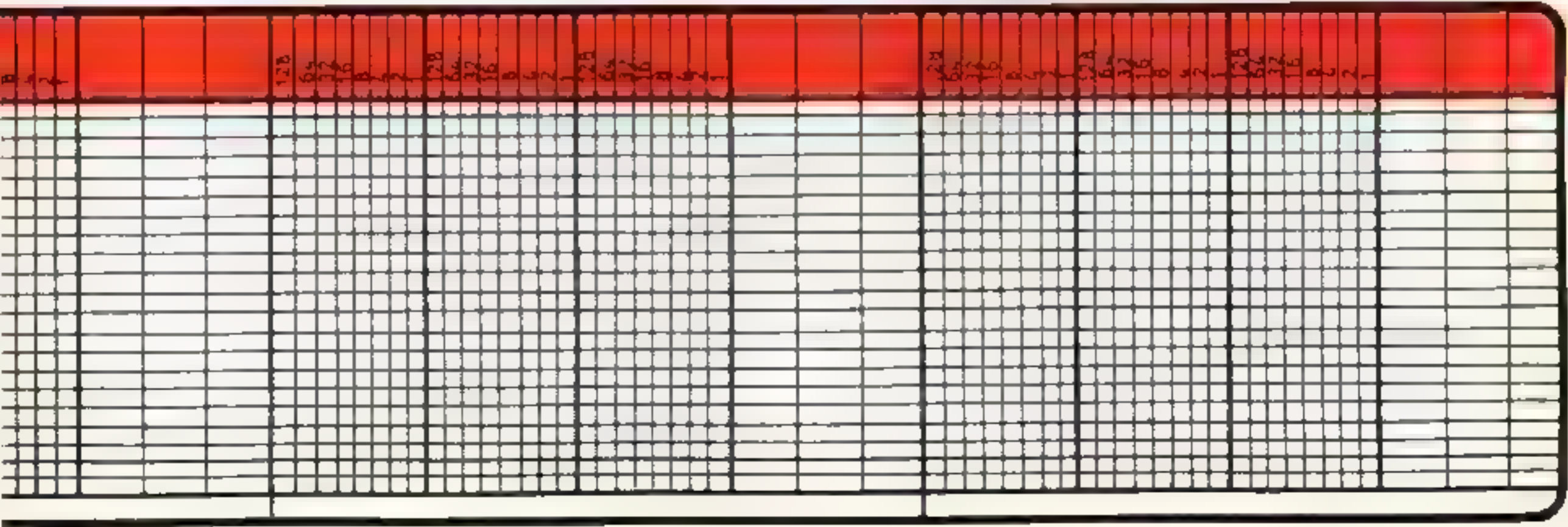
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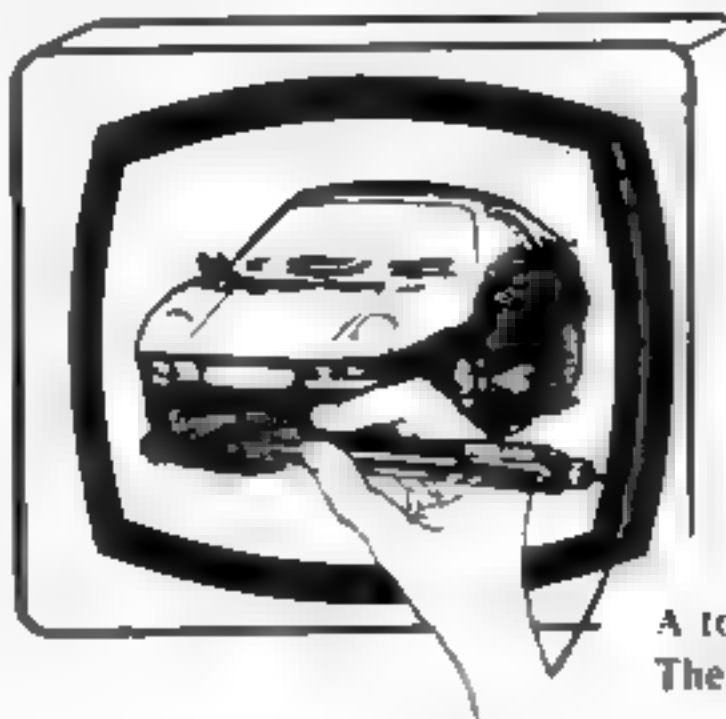
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WE'VE got together with Bubble Bus for this week's free fun-to-enter competition. And there's a bonus for 24 of our 45 prize winners — free Bubble Bus T-shirts.

Bubble Bus, which specialises in software for the VIC 20 and Commodore 64, is based in surprising surroundings for a young up-to-date company.

Its headquarters is a centuries-old oak beamed granary in Tonbridge High Street, Kent. "You have to duck as you enter each room," said the firm's Ann Lovejoy.

Among the prizes you could win is the Bubble Bus best-seller Hustler.

It's a faithful representation of pool and was written by in-house programmer Nick Strange, who is also the author of the company's table football game, Kick-Off.

Another big-selling CBM 64 title among the prizes is Bumping Buggies, a fast moving and addictive motor racing game.

It was written by 16-year old schoolboy Richard Clark who will be joining the company full time in the summer.

Flying Feathers, also for the CBM 64, puts you in the rôle of a game warden. Armed with a shotgun, your challenge is to stop eelg ex-stealing fish.

The latest of the company's games, it was written in-house by Terry Owen.

Bubble Bus was formed just a year ago by co-directors Mark Meakings and Sandy Marchant out of a company which sold business computers and software.

As well as games, Bubble Bus has a range of utilities and educational programs. Quiz Master, for the VIC 20 plus 3K memory expansion, has an educational theme and is one of our prizes.

Although most of the Bubble Bus range was written in-house, Ann Lovejoy said the company welcomed submissions from freelance programmers.

There's lots more in the pipeline from Bubble Bus she promised. There will be three more games for the Commodore 64 in June and the

Free games and T-shirts from



for our prize-winners

company is actively considering launching titles for another popular home computer.

How to enter

Study our wordsquare carefully and try to find all the Bubble Bus Software titles. All of them, plus more, are in the two lists from which the prizes will be selected.

Mark the titles you find with a semi-opaque felt tip pen or by ringing them with a ballpoint pen.

Complete the coupon fully and clearly — if you are a winner it will be used as a label — and send the wordsquare with the coupon to us. Make sure you name your computer (Commodore 64 or VIC 20 only) and if you own a VIC give its extra memory, if any.

You must write in large figures on the back of the sealed envelope the number of software titles you found. And please do not enclose anything else.

You may enter as many times as you wish, but each entry has to be on the official coupon and wordsquare and in a separate envelope. Incomplete entries cannot be considered.

Closing date is Friday May 18, 1984, at first post.

The senders of the first 45 entries opened at random, regardless of computer owned, will win the prizes. The first 24 of the 45 winning entries will also win their senders a Bubble Bus T-shirt.

The prizes will arrive from Bubble Bus within 28 days — or earlier — of the publication of the issue of Home Computing Weekly containing the names of the winners and the solution.

Address your entries to Bubble Bus Software competition, Home Computing Weekly, No 1 Golden Square, London W1R 3AB.

The prizes

Each of our 45 winners will get a prize package of three games for the VIC-20 — state your computer's extra memory, if any, on the coupon — or the Commodore 64, all drawn from the list below.

And there's an extra for the senders of the first 24 correct entries we draw. As well as three games tapes, they will get a free Bubble Bus T-shirt in bright yellow with the firm's logo in red.

The prize packages will be drawn from the following cassettes, each of which has a retail price of £6.99.

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|---------------------|-----------------|
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Note: All the VIC 20 games run on the unexpanded computer, except for Quiz Master, which requires 3K expansion.

Bubble Bus Software Competition

Entry Coupon

Name _____

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Number of titles found _____

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T	V	E	C	B	N	M	O	M	O	P	L	F	V	S	N
E	H	W	P	V	B	G	F	O	T	O	Y	V	X	B	O
R	U	E	M	D	H	V	B	J	D	P	Y	Z	G	N	F
M	L	A	C	K	A	V	E	U	X	M	I	H	S	U	U
I	X	U	E	A	F	H	O	N	G	I	K	L	O	O	P
N	G	D	E	C	T	J	Y	C	R	G	R	N	E	N	S
A	K	X	T	P	L	C	S	M	Z	I	I	G	O	T	A
T	U	W	M	I	W	C	H	U	S	T	L	E	R	M	O
O	D	B	N	J	L	A	R	K	R	J	T	B	S	V	Z
R	Z	H	X	Y	E	P	W	L	K	F	O	M	G	O	V
Y	V	D	K	B	J	C	L	T	N	B	H	U	R	B	G

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BOOM!

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How it works part 1

5 clears screen, prints prompt
10 protect top of memory
19 move ROM to RAM
20 redefine characters
40-80 data for new characters
100-115 print instructions
120-130 end of program and
wait for space bar

So she grows her hair so that her beau can climb up and rescue her

At the start of this two-part VIC-20 game you'll see Rapunzel at the top of her tower on the left and you're at the bottom right.

To make Rapunzel's hair grow you have to catch the combs, razors and tufts of hair that rain down on you. You gain five points, and Rapunzel's hair grows a little more, for each one that you catch.

part 2

8 set keyboard repeat
10-120 set up screen
170-190 move the man
800-820 end of game routine
950 re-start program

Each missed catch loses you a point and after you have missed five scissors will appear and cut off two sections of hair

When Rapunzel's hair has grown to the ground, you're able to climb up to her. The next games will be faster.

Try it and see

Variables

N time delay loop parameter, decreased as screens are completed
M your position
D object position
S flag for direction of travel
CO added to M,D for colour position
J random choice of object
H number of misses

● As usual, we have inserted REMarks in the lines above control characters as a guide to use when you are typing in the programs. These REMs should not be entered — you may run out of memory. Wherever possible, use abbreviations for keywords as given in your manual. This will ensure that the lines fit, save memory and make games run faster.

VIC-20 PROGRAM

Listing 1 — set up graphics

```
5 PRINT"PLEASE WAIT WHILST THE GRAPHICS ARE FIXED"
18 POKE52,28:POKE56,28
19 FORI=7168TO7679:POKEI,PEEK(I+25600):NEXT
20 FORI=7168TO7679:READA:IFAC<>-1THENPOKEI,A:NEXT
40 DATA8,28,8,28,28,28,8,8,9,29,10,60,92,28,34,65
45 DATA16,184,80,60,58,56,68,130,48,48,48,48,48,48,48
50 DATA0,0,254,254,170,170,170,170,24,56,84,146,162,33,33,0
55 DATA24,48,112,248,156,14,7,3,255,153,153,153,153,153,255
60 DATA0,0,192,192,96,96,48,48,20,20,37,41,41,40,255,255
65 DATA60,60,60,60,40,40,20,20,255,222,140,220,220,140,220,255
70 DATA255,123,49,59,59,49,59,255,255,255,240,120,60,30,15,255
75 DATA255,60,30,15,135,195,225,255,14,17,63,224,224,62,17,14
80 DATA192,112,28,7,3,14,56,224,0,0,28,255,127,0,0,0,-1
90 REM [CLR]
100 PRINT" ":POKE36879,152
101 PRINT"*****RAPUNZEL*****"
102 PRINT"SAVE RAPUNZEL FROM THE TOWER.CATCH THE COMBSRAZORS AND HAIR"
103 PRINT"YOU GET FIVE POINTS & RAPUNZEL'S HAIR GROWS A LITTLE FOR EACH ONE"
104 PRINT"MISS FIVE OBJECTS AND THE SCISSORS WILL COME"
105 PRINT" IF RAPUNZEL'S HAIR REACHES THE BOTTOM OF THE TOWER,A BONUS OF 10
0 IS GIVEN"
106 PRINT"*****PRESS SPACE BAR*****"
107 GETA$:IFA$=" "THEN107
108 PRINT"THE SPEED OF THE GAME IS DETERMINED BY THE"
109 PRINT" NO. OF SCREENS THAT HAVE BEEN COMPLETED."
110 PRINT"*****USE THESE KEYS TO MOVE"
111 PRINT" 'Z'-LEFT"
112 PRINT" /'-RIGHT"
113 REM[2 CRSR DOWN][BLU][RVS ON][RED][RVS OFF][BLU]
115 PRINT"*****PRESS SPACE BAR*****"
120 POKE198,0:WAIT198,1
130 PRINT"PRESS SHIFT/RUN TO LOAD PART TWO"
```

Listing 2 — main game

```
8 POKE36879,56:POKE650,128
9 REM[CLR]
10 PRINT" ":M=8155:H1=7772:H=0:POKE36869,255
12 FORI=7792TO8056STEP22
14 POKEI,11:POKEI+1,12:POKEI+CO,6:POKEI+CO+1,6:NEXT
16 FORI=7708TO8148STEP22:POKEI,7:POKEI+15,7:POKEI+CO,7:POKEI+15+CO,7:NEXT
18 POKE7771,10:POKE7749,9:POKE38491,15:POKE38469,15:POKE7750,8:POKE7750+CO,0
19 POKE7772,3:POKE7772+CO,0
20 POKEM,0:POKEM+CO,0
100 D=INT(RND(1)*13)+7709
110 S=INT(RND(1)*2)+1
120 J=INT(RND(1)*3)+4:IFS=1THEN190
140 POKED,32:IFPEEK(D+23)<>32THEN170
150 D=D+23:POKED,J:POKED+CO,0
155 POKE198,0:FORDL=0TON:NEXT
160 IFD>8169THENPOKED,32:S=3:H=H+1:SC=SC-1:GOTO260
165 GOTO260
170 IFPEEK(D+23)=10RPEEK(D+23)=10RPEEK(D+23)=2THENPOKED,32:GOSUB300:S=3:GOTO260
180 S=1:GOTO260
190 POKED,32:IFPEEK(D+21)<>32THEN230
200 D=D+21:POKED,J:POKED+CO,0
205 POKE198,0:FORDL=0TON:NEXT
210 IFD>8169THENPOKED,32:S=3:H=H+1:GOTO260
225 GOTO260
230 IFPEEK(D+21)=0RPEEK(D+21)=10RPEEK(D+21)=2THENPOKED,32:GOSUB300:S=3:GOTO260
240 S=2:GOTO260
```


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